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(Hybrid Poplar)

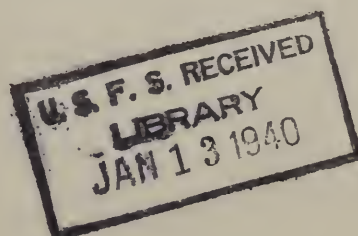
PERFORMANCE OF HYBRID POPLAR CUTTINGS IN THE FORESTSERVICE NURSERY, VALLONIA, INDIANA*By George Gruscho*

Cuttings representing twenty-five hybrid poplar clones, furnished by the Northeastern Forest Experiment Station, were planted in the Forest Service nursery at Vallonia, Indiana, early in April, 1938. This was in accordance with the plan of that Station to evaluate the clones growing under different climatic conditions throughout the country. The cuttings, uniformly twelve inches in height and varying in diameter, were received and stratified at the nursery in the fall of 1937.

NURSERY PLOT ESTABLISHMENT

The plantings were made in a nursery unit in randomized plots to permit scrutiny of quantitative differences in behavior. The planting stock of each clone was divided into two lots of equal numbers, making a total of fifty lots, thus affording two replications for each clone. Every lot was assigned a random position in the unit, Figure 1. The individuals within a replication were planted approximately six inches apart in rows four feet apart. Each lot was adequately labeled for subsequent identification.

The cuttings, with a planted height of four inches, were set eight inches in the soil. The diameter of each cutting, at a point three inches above the ground, was recorded soon after planting.



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Figure 1. Randomized plots of hybrid poplars at the Vallonia Nursery,
Block IV, Sec. IV, Unit 12.

Row 1	OP - 39	OP - 6	OP - 43	OP - 47	OP - 32	OP - 2	OP-42
Row 2	OP - 6	OP - 21	OP - 46	OP - 56	OP - 45	OP - 21	OP-29
Row 3	OP - 23	OP - 48	OP - 52	OP - 4	OP - 50	OP - 3	OP-29
Row 4	OP - 37	OP - 4	OP - 50	OP - 47	OP - 23	OP - 41	OP-52
Row 5	OP - 28	OP - 12	OP - 32	OP - 2	OP - 33	OP - 48	OP-54
Row 6	OP - 54	OP - 45	OP - 3	OP - 42	OP - 56	OP - 46	OP-39
Row 7	OP - 9	OP - 43	OP - 37	OP - 33	OP - 28	OP - 12	OP-41
Row 8	OP - 9						

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CLIMATIC CONDITIONS

Weather records kept by the Vallonia Nursery furnish accurate data on the general climate of the planting site. The climatological data for the duration of the period over which observations on the cuttings have been made are summarized in Table 1. Quite adequate rainfall was well distributed throughout the growing season, and it will be noted that the winter temperatures were unusually mild for this region.

SOIL

The soil at the Vallonia Nursery is a deep alluvial deposit, classified as a Princeton sandy loam, part of a terminal moraine of an early glaciation. It is very well drained, well aerated and well oxidized; low in essential mineral elements because of excessive leaching; and low in organic material because of previous cultivation.

TREATMENT AND CARE

Maximum care was given the cuttings during the growing season. The unit, in which the planting was made, was kept weed-free by cultivation. The rows were cultivated once a week during the month of May, once every two weeks during June and July, and once in August. After that time, the cuttings had attained such a size, and the period of establishment of the weeds had so far progressed that no weeds developed in the unit.

Table 1. Climatological Data - Vallonia, Indiana 1938 - 1939

MONTH	RAINFALL IN INCHES	AVERAGE DAILY MAXIMUM TEMP. ° FAHRENHEIT	AVERAGE DAILY MINIMUM TEMP. ° FAHRENHEIT
April '38	1.17	68.5	43.3
May '38	4.35	74.7	50.9
June '38	4.10	74.0	57.5
July '38	6.89	86.0	62.9
August '38	2.00	86.9	62.8
September '38	1.75	81.8	55.8
October '38	.66	74.6	38.9
November '38	4.65	58.2	31.2
December '38	1.56	48.0	23.7
January '39	5.12	48.2	27.6
February '39	4.75	46.8	20.7
March '39	6.91	56.4	31.9

Table 1

The following table shows the results of the experiment. The first column shows the number of trials, the second column shows the number of correct responses, the third column shows the number of incorrect responses, and the fourth column shows the percentage of correct responses.

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Table 1. Results of the experiment.

Number of trials	Number of correct responses	Number of incorrect responses	Percentage of correct responses
10	8	2	80%
20	15	5	75%
30	22	8	73%
40	28	12	70%
50	35	15	70%
60	40	20	67%
70	45	25	64%
80	50	30	63%
90	55	35	61%
100	60	40	60%
110	65	45	59%
120	70	50	58%
130	75	55	57%
140	80	60	57%
150	85	65	57%
160	90	70	56%
170	95	75	56%
180	100	80	56%
190	105	85	55%
200	110	90	55%

No irrigation or watering of the cuttings was necessary due to the adequate precipitation during the major part of the growing season.

Insect injury became evident on the foliage of some of the clones early in the summer. This became severe, and three separate applications of lead arsenate spray were made but with only temporary effect in each case. Apparently the many simultaneous broods and the presence of different instars of the defoliating insect, which was identified as the Cottonwood Leaf-bottle (Lina scripta Fabr.), accounted for the recurrence of the beetles after the toxic effects of the arsenate spray had diminished. A later application of a spray mixture of lead arsenate and nicotine sulphate was effective in checking the insect damage to a considerable extent.

OBSERVATIONS AND DATA

A field examination of the clones was made on September 15, 1938, but as the growing season had not yet ended, no quantitative measurements were made at this time. This examination disclosed that four clones had been affected by a leaf rust (Melampsora sp.). The rust was evident upon both replications of the clones affected and was apparently not as severe upon the clone OP-33 as it was upon the other three infected clones: OP-32, OP-37, and OP-39.

The extent of beetle injury varied somewhat among the different clones, but was comparatively the same upon the two replicates of an individual clone. The clones, which appeared to be damaged to such an extent that the injury would be a serious factor in the establishment of the cuttings if unprotected by application of sprays, were noted and are indicated in Table 2.

Consistency in leaf shape and size was evidenced within the replications of a clone, and a wide variation in these characters was noted between the clones of the entire series. Both replications of the individual clones were consistent in all the exterior evidences of growth; size, form, branchiness, etc.

Table 2. Behavior of hybrid poplar cuttings in the Vallonia Nursery

Clone No.	Number of Cuttings Planted	Survival		Rust on Leaves Sept. 15	Branchiness in Number of Branches	Mean Diameter Increment Inches/10	Mean Height in Feet	Heavy Insect Attack
		Each Rep-lication 1	2					
OP - 2	100	49	47		57	4.3	7.8	
OP - 3	100	49	46		28	3.4	8.2	
OP - 4	101	49	49		20	3.0	7.2	*
OP - 6	100	50	50		17	3.3	8.6	
OP - 9	100	50	50		68	2.6	6.6	*
OP - 12	100	44	50		18	2.1	7.0	*
OP - 21	100	38	39		24	3.4	8.0	
OP - 23	95	42	34		8	1.9	6.6	
OP - 28	100	40	45		17	2.4	6.5	*
OP - 29	100	50	50		5	3.2	8.3	
OP - 32	100	29	30	*	14	3.1	6.0	*
OP - 33	100	36	44	*	9	2.0	5.9	
OP - 37	100	42	41	*	25	2.8	5.4	*
OP - 39	100	48	46	*	25	2.0	5.7	
OP - 41	100	49	48		15	2.2	7.6	
OP - 42	100	50	49		1	2.8	7.4	
OP - 43	100	50	47		2	2.3	6.6	*
OP - 45	100	50	50		5	2.4	7.5	*
OP - 46	100	50	48		10	2.0	7.3	*
OP - 47	100	49	42		10	2.9	6.8	*
OP - 48	160	46	50		6	2.1	6.7	
OP - 50	100	47	44		3	2.4	7.3	*
OP - 52	100	49	46		5	2.3	6.4	
OP - 54	100	49	50		29	2.8	7.3	
OP - 56	99	44	39		27	2.7	6.6	*

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Measurements were taken on the individual cuttings on November 8, 1938, after the growth had ceased. Diameters were measured at a point three inches above the ground in order to be comparable with the diameters taken at the time of planting. Total height was measured to the nearest half-foot. A total height measurement is assumed to be a valid expression of height increment because of the uniformity of the planted heights of the cuttings. The mean diameter increment and the mean height increment for each replication of every clone were computed from these data. For purposes of analysis these means were kept separate, but for general comparison, the values for the replicates of each clone were weighted and averaged to give a single value of height and diameter increment for each clone. These latter data appear in Table 2. The height value was changed from half-foot units to feet in order to give a more readily applied basis of comparison.

Individual clones varied from one another in the number of branches produced, but replications of individual clones were apparently consistent in this respect. An attempt was made to give a comparative figure for the characteristic of branchiness of the clones. A tree which was considered to be average was selected by inspection in each clone. The number of branches on this "average" tree were then counted and this number used as a basis for evaluating the clones as to branchiness. This value is tabulated in Table 2. The method is not a precise one, but it does convey the significant range of the variation of the clones in respect to the number of branches produced.

Cuttings were made in the late fall of most of the individuals in each clone. These cuttings were bundled by clones, and stratified in sand. A few representatives of every clone were left standing in the nursery unit over the winter. Examination of these specimens in the spring indicated that no dying back due to winter conditions had occurred in any of the clones.

The cuttings were taken from stratification in March 1939 and planted in experimental plots. Early observations upon these field planted cuttings indicate that the clones vary in the time of bud development or breaking of dormancy. The clones were evaluated as to the extent to which they had broken dormancy at the time of observation, April 21, 1939, and these data are shown in Table 3. Each of the four main groups of this table is further subdivided into two classes separated by a space. The first class in each group is the one which is the further advanced.

Table 3. Extent to which clones had broken dormancy by the end of April. Observations on field planted cuttings.

Clones in which leaves were well developed	Clones in which leaves were unfolding	Clones in which buds were break- ing	Clones in which buds were swollen
OP - 41	OP - 28	OP - 23	OP - 9
OP - 45	OP - 29	OP - 42	OP - 37
OP - 46	OP - 33		
OP - 50	OP - 54	OP - 21	OP - 3
	OP - 56	OP - 12	
OP - 4			
OP - 43	OP - 6		
OP - 52	OP - 32		
	OP - 39		
	OP - 48		
	OP - 2		
	OP - 47		

ANALYSIS OF GROWTH DATA

The mean diameter and mean height increments for each replicate of every clone were individually subjected to an Analysis of Variance. This inspection showed a non-significant variation in each case. The mean diameter increment showed nearly as great a range between replicates of a single clone as it did between the clones, consequently no further examination of these data was considered necessary.

The means of the heights for clones show a range of from 10.9 to 17.3 (half-foot units). The clones were arranged according to their mean height and the significance of variation of the means, using the lowest value (10.9) as the basis, was computed.

These calculations resolved the clones into three distinct groups; those whose mean height does not vary significantly from the mean height of the shortest clone, those whose mean height does vary significantly, and those whose mean height varies highly significantly with the mean height of the shortest clone. The results obtained by this comparison are set forth in Table 4.

In examining Table 4, it is interesting to note that the four clones with the lowest mean height values are those which were affected by the *Melampsora* rust.

The cuttings were grouped into their respective planted diameter classes irrespective of clones, and the mean height and percent mortality were computed for each diameter class. These data are contained in Table 5. There is apparently no great significant difference either in height growth or mortality for the individual planted diameter classes. The data in Table 5 however do indicate that height increment does not show a large increase with an increase in the planted diameter of the cutting within the limits of the data gathered in this instance.

Table 4. Comparison of the mean heights of clones with the lowest mean height, that of clone OP-37.

Clones whose mean height varies non-significantly with the lowest mean height (10.9)		Clones whose mean height varies significantly with the lowest mean height		Clones whose mean height varies highly significantly with the lowest mean height	
Clone No.	Mean height in $\frac{1}{2}$ ft. units	Clone No.	Mean height in $\frac{1}{2}$ ft. units	Clone No.	Mean height in $\frac{1}{2}$ ft. units
OP - 37	10.9	OP - 4	14.4	OP - 21	16.0
OP - 39	11.4	OP - 46	14.6	OP - 3	16.4
OP - 33	11.8	OP - 50	14.6	OP - 29	16.6
OP - 32	12.0	OP - 54	14.6	OP - 6	17.3
OP - 52	12.7	OP - 42	14.8		
OP - 28	13.0	OP - 45	15.0		
OP - 43	13.1	OP - 41	15.1		
OP - 56	13.2	OP - 2	15.6		
OP - 23	13.3				
OP - 9	13.3				
OP - 48	13.4				
OP - 47	13.6				
OP - 12	13.9				

Table 5. Behavior of cuttings according to diameter class.

Diameter Class in Tenth/inches	No. Planted	No. Surviving	Total Height	Mean Height	No. Dead	Per Cent Mortality
.1	1	"	"	"	1	100
.2	665	561	7,724	13.8	104	16
.3	1,354	1,281	18,268	14.3	73	5
.4	386	371	5,319	14.3	15	4
.5	68	60	812	13.5	8	12
.6	16	16	221	13.8	0	0
.7	4	4	50	12.5	0	0

SUMMARY

Cuttings of twenty-five clones of hybrid poplar were set out in the Forest Service Nursery at Vallonia, Indiana, in the spring of 1938. Observations were made on the behavior of the cuttings in the nursery at the end of the first growing season. Cuttings were made from this planting and stratified over winter. These cuttings were planted under field conditions in the spring of 1939.

The clones sorted out into a definite order in respect to increment and general behavior during the first growing season.

Differential resistance of the clones to insect and fungous attack was manifested during the growing season in the nursery.

No correlation was found, within the scope of the data, between planted diameter of the cuttings and increment.

There was no winter mortality or dying back due to winter conditions on the individuals left in the bed at the Vallonia nursery during the winter of 1938 - 1939.

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